

## WHAT IS CLAIMED IS:

1. An electron beam source for generating a beam of electrons, the electron beam source comprising:

a cathode body having a source surface for emission of electrons;

an anode disposed at a distance from the cathode body, for generating an extraction field for extracting the electrons from the source surface;

a heater for heating the cathode body;

a photon source for generating at least one photon beam directed onto the source surface for assisting in the electron emission, wherein the photon source is configured such that an intensity of the at least one photon beam is adjustable;

a detector for detecting a beam current of the electron beam and for providing a measuring signal representing the electron beam current; and

a controller configured to control the intensity of the photon beam based on the measuring signal in a normal mode of operation of the electron beam source,

wherein, in a mode of operation different from the normal mode of operation and in which the photon beam is not directed onto the source surface, the electron beam current is higher than about 0.3 times the electron beam current in the normal mode of operation.

2. The electron beam source according to claim 1, wherein, in the different mode of operation in which the photon beam is not directed onto the source surface, the electron beam current is higher than about 0.65 times the electron beam current in the normal mode of operation.

3. The electron beam source according to claim 1, wherein, in the different mode of operation in which the photon beam is not directed onto the source surface, the electron beam current is higher than about 0.80 times the electron beam current in the normal mode of operation.

4. The electron beam source according to claim 1, wherein a maximum intensity of the photon beam in the normal mode of operation is limited such that a temperature of the source surface is below about 1300 K in a mode of operation different from the normal mode of operation and in which no other energy is supplied to the cathode body apart from the photon beam.

5. The electron beam source according to claim 1, wherein a maximum intensity of the photon beam in the normal mode of operation is limited such that a temperature of the source surface is below about 1100 K in a mode of operation different from the normal mode of operation and in which no other energy is supplied to the cathode body apart from the photon beam.

6. The electron beam source according to claim 1, wherein the heater comprises an electrical resistance heater.

7. The electron beam source according to claim 1, wherein the controller is configured to control the photon source such that the electron beam current is substantially constant in time in the normal mode of operation.

8. The electron beam source according to claim 1, wherein a mirror deflecting the at least one photon beam is disposed in a beam path of the at least one photon beam between the photon source and the source surface.

9. The electron beam source according to claim 8, wherein the mirror is provided on an aperture beam stop traversed by the electron beam.

10. The electron beam source according to claim 8, wherein the mirror is of a substantially parabolic shape.

11. The electron beam source according to claim 1, wherein plural photon beams are directed onto the source surface.

12. The electron beam source according to claim 1, wherein the detector is configured to detect an intensity of emitted electrons incident on an aperture beam stop traversed by the electron beam.

13. The electron beam source according to one of claim 1, wherein the source surface of the cathode body is made of a material comprising barium oxide.

14. The electron beam source according to claim 1, wherein, in the normal mode of operation, the source surface is at a working temperature, and wherein the photon source is configured to increase the intensity of the photon beam in an annealing mode of operation different from the normal mode of operation such that the temperature of the source surface is more than about 100 K above the working temperature.

15. The electron beam source according to claim 1, wherein, in the normal mode of operation, the source surface is at a working temperature, and wherein the photon source is configured to increase the intensity of the photon beam in an annealing mode of operation different from the normal mode of operation such that the temperature of the source surface is more than about 200 K above the working temperature.

16. The electron beam source according to claim 1, wherein, in the normal mode of operation, the source surface is at a working temperature, and wherein the photon source is configured to increase the intensity of the photon beam in an annealing mode of operation different from the normal mode of

operation such that the temperature of the source surface is more than about 300 K above the working temperature.

17. An electron optical apparatus comprising:

5 an objective lens for focusing a beam of electrons at a location in an object plane of the objective lens, and an electron beam source for generating the beam of electrons, the electron beam source comprising:

a cathode body having a source surface for emission of electrons;

10 an anode disposed at a distance from the cathode body, for generating an extraction field for extracting the electrons from the source surface;

a heater for heating the cathode body;

a photon source for generating at least one photon beam directed onto the source surface for assisting in the electron emission, wherein the photon source is configured such that an intensity of the at least one photon beam is adjustable;

15 a detector for detecting a beam current of the electron beam and for providing a measuring signal representing the electron beam current; and

a controller configured to control the intensity of the photon beam based on the measuring signal in a normal mode of operation of the electron beam source,

20 wherein, in a mode of operation different from the normal mode of operation and in which the photon beam is not directed onto the source surface, the electron beam current is higher than about 0.3 times the electron beam current in the normal mode of operation.

18. The electron optical apparatus according to claim 17, further  
25 comprising a detector for detecting secondary electrons emanating from the object.

19. The electron optical apparatus according to claim 17, further comprising a deflector for scanning the location at which the electron beam is focused in the object plane.

20. A method for operating an electron beam source comprising a cathode body having a source surface, wherein the method comprises operating the electron beam source in a normal mode of operation, wherein, in the normal mode of operation:

5 the cathode body is heated;

the source surface is illuminated with a photon beam of an adjustable intensity;

electrons are extracted from the source surface, and the extracted electrons are shaped to form the electron beam;

10 a quantity representing an intensity of the electron beam is measured; and an intensity of the photon beam is controlled based on the measured quantity;

and wherein the cathode body is heated in the normal mode of operation such that in a mode of operation different from the normal mode of operation, in which the source surface is not illuminated with the photon beam and in which the cathode body is heated in the same manner as in the normal mode of operation, the intensity of the electron beam is higher than about 0.3 times the intensity of the electron beam in the normal mode of operation.

20 21. The method according to claim 20, further comprising operating the electron beam source in an annealing mode of operation, wherein, in the annealing mode of operation, the intensity of the photon beam is increased with respect to the intensity of the photon beam in the normal mode of operation during a duration such that the temperature of the source surface is higher than the temperature of the source surface in the normal mode of operation by more than about 100 K.

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